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Sustainable livestock production? Industrial agriculture versus pastoralism

Feeding our growing world population and preserving our natural resource base is a major agricultural challenge set to get harder. Despite agricultural productivity gains in many areas, roughly a billion people continue to suffer from chronic hunger.[1] Meanwhile, we will likely add about 2.5 billion people to the planet by 2050.[2] Yet providing enough nutrition for current and future generations is entirely possible, if we make the best use of Earth's finite natural resources, especially arable land. Notably, one agricultural sector – livestock – places excessive demands on our resource base. But this is mainly due to globalized, industrial meat production methods. Tragically, the most sustainable livestock producers – herders and other mobile, smaller-scale livestock keepers – have been marginalized by mainstream agricultural policy for decades. It is high time for a course correction.

The research featured here is focused globally.

Many demands, limited land

"Buy land, they're not making it anymore" goes an old quote attributed to writer Mark Twain. Its core insight – that land is a finite, valuable resource – is truer today than ever before. Our limited land must feed, shelter, and clothe rapidly growing numbers of people, and is also increasingly called upon to produce crops for biofuels and other industrial uses. Agriculture today claims roughly 38% of Earth's land surface, making it the biggest form of land use globally.[3]

Despite population growth, the net land area under agriculture has only increased by about 3% in the last few decades.[4] This is probably because agricultural intensification – use of irrigation, fertilizers, pesticides, and heavy machinery – has made it possible to increase crop yields in many

KEY MESSAGES

- Feeding our growing world population demands sustainable use of natural resources, especially arable land.
- Livestock production overall claims excessive shares of land and crops – including crops that could be eaten directly by human populations. Trends suggest that global livestock production and consumption will grow even further, with possibly grave environmental consequences.
- But not all forms of livestock production are wasteful and energy-intensive. People who herd animals or combine livestock keeping and cropping at a smaller scale – called pastoralists or agro-pastoralists – can sustainably produce meat, milk, and other animal products. But they require support, especially in resource (e.g. pasture) management, livestock health, and marketing.
- Consumer choice plays a big role. We can "have our steak and eat it, too" – i.e. enjoy animal products *and* protect our planet – only if we consume such products *less often* and focus on sustainably produced goods.

Defining pastoralism

According to the FAO (2001), pastoralism is "the use of extensive grazing on rangelands for livestock production". It includes extensive enclosed systems found in North America, Australia, and parts of South America, as well as "open access" systems in Africa, the Andes, Asia, and Siberia. Pastoral livestock production currently generates roughly 10% of the meat humans consume, while supporting approximately 1 billion people globally.[14]

Box 1. Pastoralists in Tanzania: Feeding their people, neglected by policy

Pastoral groups have herded animals for millennia in the savannahs of eastern Africa. In Tanzania, pastoral production accounts for roughly 90% of the meat and 70% of the milk consumed.[24] This makes it the country's *de facto* livestock sector. Yet the Tanzanian government appears very ambivalent about pastoralism in its official livestock policy (2006)[25], stating its aim for a sector that is "commercially run, modern and sustainable, using improved and highly productive livestock" by 2025. Recent CDE research shows the harms (e.g. cattle deaths, farmer–pastoralist conflict) of forced relocation of pastoralists, who were blamed for overusing wetlands in central Tanzania (Mwambene et al. 2014).[26] But pastoralists' overuse of water or grazing areas, where it occurs, is mainly a symptom of their losing land to parks, protected areas, and game reserves (collectively over 25% of national land)[27], and increasingly to foreign investors[28] (e.g. for tobacco or biofuels). Legally protecting and allocating enough grazing land for pastoralists in Tanzania is a core challenge. With proper support, they can continue to form the "modern and sustainable" core of Tanzania's livestock sector in the future.

places. But it also suggests that agricultural expansion may be pushing against limits such as physical infrastructure (e.g. urban development), ecological constraints (e.g. water scarcity), and competition with other land uses (e.g. conservation areas).

Further, the places where limited agricultural expansion is occurring – via land conversions – are a cause for concern. Especially in the tropics, agricultural expansion is coming at the expense of highly biodiverse land cover. What is particularly troubling is that forests are being cut to make way for cropland, grazing land, and timber plantations. Such deforestation is estimated to account for about 11% of annual greenhouse gas emissions.[5]

Land use for livestock

With agricultural expansion facing limits and risks, the key question then is: *How well are we using the huge share of Earth's land surface devoted to agriculture?*

Strikingly, aggregated global data show one sector dominating all other agricultural land uses by a wide margin: livestock production. Over 40 years after Frances Moore Lappé first prominently emphasized the resource risks of livestock production,[6] modern scientific methods (e.g. geographic information systems) only reinforce the concerns she raised: Today, roughly three-quarters of agricultural land is used to produce meat, milk, and other animal products, if we include pasturing. By contrast, only one-quarter is used to produce cereals, vegetables, tuber crops, and other plants for direct human consumption and other uses.[7] Of cereal crops grown globally, 40% is estimated to be fed to livestock – including to ruminant livestock (e.g. cattle) that are better suited to eating grass and forage.[8]

Besides outsize land and crop consumption, a host of other environmental risks are associated with the livestock sector globally. It is responsible for an estimated 18% of the world's greenhouse gas emissions, or an astonishing 80% of those associated with agriculture.[9] It also directly and indirectly contributes over half of reactive nitrogen pollution worldwide, with harmful effects on water quality, air quality, soil fertility, biodiversity, and more.[10]

Need to differentiate

Nevertheless, these harmful effects must be weighed against the reality that the livestock sector remains a vital source of employment and food security, especially in developing countries where it contributes up to 80% of agricultural GDP and is a major source of livelihood for roughly 600 million rural poor.[11] To chart a sensible way forward, critical distinctions must be made between more or less sustainable forms of livestock production.

Industrial livestock production

Despite a dearth of properly disaggregated data, it is clear that heavily industrialized, highly intensive livestock production – especially feedlot-reliant "factory farming" – is responsible for a majority of the worst environmental impacts related to the sector. It depends heavily on external inputs, especially imported feed grown as huge monocultures of crops such as maize or soya. Once found mainly in rich, Northern countries, these feedstock monocultures are increasingly eating up valuable forests and farmland in South America and even Africa.[12] Growing feed crops in this way requires heavy use of irrigation water, fertilizers that cause nitrogen pollution, environmentally harmful pesticides and herbicides, and fossil fuels (e.g. for mechanized seeding, spraying, harvesting, and especially global transport). Rising animal feed imports by rich countries (e.g. OECD or G20 member states) mean that related resource use challenges are just being shifted to poorer developing countries. Since the conversion rate of plant to animal matter is only about 10%,[13] a huge amount of resources are required to obtain a relatively small amount of meat protein.

Pastoral and mixed crop–livestock production

Contrasting sharply with this industrial production model are the livestock-rearing methods of smaller-scale livestock keepers who graze their animals on rangelands and keep them moving. People described as herders, shepherds, nomads, transhumant people, pastoralists, agro-pastoralists, and (depending on local rules) organic farmers all generate animal products and other services in a far more sustainable way, if properly supported. Instead of using external inputs, they mainly rely on what the local or regional ecosystem can provide – namely the grass, scrub, or stubble on which their animals graze and forage. This turns fibrous plant material into milk, meat, and other animal products (e.g. wool). Crucially, their lifestyle requires mobility and dynamic pasture management to use resources efficiently and prevent overgrazing. Globally, livestock grazing occurs on as much as 26% of Earth's land, much of it arid or semiarid rangeland unsuited to cultivation.[15] Advantages of pastoralism include:

Local adaptation. Whether practised in the African savannahs, grasslands of Central Asia, Scottish highlands, or Swiss Alps, mobile livestock keeping is generally carefully adapted to the local ecosystem, having evolved over many generations. Pastoralists tend to keep specific (indigenous) livestock breeds[16] – cattle, goats, sheep, camels, buffaloes, yaks, etc. – that are capable of thriving on (often sparse) local vegetation. Use of these locally adapted breeds enables pastoralists to produce food and other goods in landscapes unsuited to cropping, such as steep mountain

areas and drylands with unpredictable rainfall. In addition, these breeds often have higher reproductive rates and better disease resistance than "high-yield" imported breeds (e.g. Holstein Friesian).[17]

Greater efficiency. In studies in African countries, pastoral livestock production was found to deliver higher returns per hectare than more capital-intensive alternatives, if pastoralism´s added benefits are properly valued.[18] Besides producing milk and meat, pastoralism also generates transport, draught power, and manure for use in agriculture. It supports self-sustaining, *closed production cycles* in which by-products like manure serve as fertilizer for grazing areas and crops, with crop residues often fed back to animals.[19]

Higher quality. The meat of grazing animals is generally leaner, and their milk often more nutritious – e.g. richer in omega-3 fatty acids and antioxidants – if grasslands, forage areas, and animal health are properly managed.

Ecosystem services. Pastoralists and their animals often act as custodians to grasslands and biodiverse landscapes, preserving soils capable of sequestering carbon, properly regulating water cycles, regenerating natural vegetation, and preventing natural hazards (e.g. fires).[20,21] Grazing animals return nutrients to soils and even disperse seeds through their dung.[22] Especially in drylands, which cover 40% of Earth's land surface, properly managed ruminants support healthy landscapes that act as carbon sinks. Grasslands hold over one-third of Earth's carbon stocks.[23]

Cultural and social services. Whether the Maasai in Tanzania or Swiss Alpine farmers, mobile livestock keepers are often one of the first images people associate with a specific region or country. They keep alive traditions and visibly shape landscapes that attract tourists and related investments, as well as providing a sense of regional identity. They also preserve age-old human practices of managing resources – e.g. pastures – held in common, not privately.

Ignored value, untapped potential

Tragically, the many benefits of pastoral livestock production have been largely ignored or marginalized by mainstream economic and agricultural development policies for several decades. The reasons vary from location to location. In North America and Europe, for example, an unrelenting post-war push to increase livestock productivity led farmers to gradually move away from extensive pasturing of animals in favour of rapidly fattening them up in stationary feedlots. In Africa, by contrast, pastoral groups – often ethnically defined – were frequently victims of systematic discrimination by colonial and post-colonial leaders who viewed their highly mobile lifestyle as anti-modern (see Box 1).[29] Alternatively, they have simply been ignored or kept invisible by census or survey methods that fail to capture them,[30] also leading to their political exclusion and neglect in strategies of (sustainable) development. This is despite the major economic contributions they make (e.g. USD 800 million annually in Kenya)[31], if properly evaluated.[32] Finally, competing land claims – for everything from cash crops to conservation or urban areas – make it increasingly difficult for pastoralists to roam widely enough and feed their animals sustainably.

Of course, pastoral livestock production also has limitations. But many of its weaknesses – including risks of overstocking and overgrazing, animal diseases, poor market integration, and social exclusion – could be solved with proper investment and support. Problems of pastoral animal health in parts of Africa and Central Asia, for example, could be solved by investing in herd management and mobile veterinary services (e.g. brucellosis vaccination).[33] Such health interventions seem modest compared with, for example, the large-scale prophylactic use of antibiotics in industrial livestock production.

In the end, we can still change course and realize the potential of pastoralism. Crucially, the just-launched Sustainable Development Goals (SDGs) explicitly include pastoralists in their goal to end hunger, "through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition".[36] Budding pastoral-support programmes in Europe show promise, especially where consumer demand for organic, sustainably produced food is rising (see Box 2). But much more must be done to protect pastoralists in poorer developing countries, where competing land claims – including "land grabs" by foreign investors – pose the gravest threat to the food security provided by mobile livestock keeping.

Box 2. Pastoralism in Europe and Switzerland: Facing change, but receiving support

Despite recent declines in the number of livestock keepers, pastoralism remains prevalent in Europe, especially "transhumance", in which herders move animals between highland and lowland areas according to seasonal grazing cycles. Sheep and goat herders in countries like France and Spain, for example, have carved out niches selling (often specially labelled) products like artisanal cheeses. The European Union's Common Agricultural Policy enables member countries to support farmers, including pastoralists, with price guarantees and direct payments – including payments for ecosystem services. Similar schemes support pastoral producers in Switzerland.[34]

Switzerland shows both the promise of pastoralism and the sober reality of current consumption patterns. Certified organic Swiss dairy products enjoy a respectable market share of about 10%, and are often produced by livestock keepers using pastoral methods (e.g. 90% of animal feed, mainly grass/hay, must be local to obtain *BioSuisse* certification). But the market share of pastorally produced meat is much smaller, likely because of its substantially higher price compared to conventionally produced meat. Moreover, conventional Swiss livestock producers generally depend on imports (85%) for the grain and soy concentrates used to fatten their cattle, pigs, and poultry.[35]

A member of the Hamer tribe in southern Ethiopia herding goats. Photo: F.U. Höggel

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Policy implications of research

Acknowledge the unsustainability of industrial livestock production
Roughly 40% of the world's cereal crops are fed to animals, not humans, to make meat and milk industrially. Feed monocultures that rely on mechanization, heavy irrigation, chemical fertilizers, and pesticides are increasingly eating up biodiverse land, vital forests, and grazing areas in developing countries. Projections of doubling meat production by 2050 ignore that this could push greenhouse gas emissions, biodiversity loss, and nitrogen pollution far beyond humanity's safe operating space.[37]

Internalize the externalized costs
Yet the environmental costs of industrial livestock production remain hidden from consumers. Increasing the price of carbon (e.g. fossil fuels), levying fines for pollution, charging for water use, etc. would help eliminate this market distortion.[38] Momentum is growing for mandatory carbon price increases, especially in an effort to tackle climate change.[39] Such measures should be carefully calibrated not to harm poor consumers, especially in developing or transition countries.

Properly value and support pastoral livestock keepers
Smaller-scale livestock keepers who graze their animals and keep them moving to avoid resource depletion are among the most sustainable producers of meat, milk, and other animal products. By feeding their ruminant livestock grass or forage rather than crops, they increase global food security and reduce pressure on land. Pastoralists should be supported with targeted policies and investments. These include: estimating pastoralists' *total economic value*[40] (e.g. food and ecosystem services); protecting their *mobility* (e.g. via access rights); providing custom *extension services* (e.g. herd/pasture management); offering tailored *health and social services* (e.g. mobile clinics, schools); helping them *integrate in local and regional markets* (e.g. meeting consumer safety standards, packaging, transport); and *certifying and labelling* their goods for consumers.

Eat less meat, and consume only sustainably produced goods
Consumers can be the biggest agents of change in the shift away from industrial livestock production. Policymakers can promote sustainable consumption with action plans comprising a mix of policy instruments (e.g. information campaigns, taxes, subsidies). Consumers in rich countries (e.g. US, EU) and emerging economies (e.g. China, India) arguably have the biggest responsibility to stop eating animal products that strain Earth's finite resources.

Suggested further reading

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[38]For more on "Polluter Pays" and "User Pays" principles and other policy measures to reveal the hidden costs of industrial livestock production, see: "Maintaining harmony: Equitable and efficient means to minimise adverse impacts of livestock on the environment" at http://www.fao.org/ag/againfo/programmes/en/lead/toolbox/Policy/MainHarm.htm

[39]For more on the prospect of taxing or pricing carbon to reflect its impacts, which could also increase the price of industrial livestock products, see: "Leaders Unite in Calling for a Price on Carbon Ahead of Paris Climate Talks" at http://www.worldbank.org/en/news/press-release/2015/10/19/leaders-unite-in-calling-for-a-price-on-carbon-ahead-of-paris-climate-talks; see also: "Carbon Fee and Dividend Primer: Why Put a Price on Carbon?" at http://poeteconomist.com/pricing-carbon/

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